Special Issue:
Best in China – Smart Manufacturing

Editorial

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The guest editors are delighted to present this special issue to international researchers and practioners in the manufacturing and related industries, especially in high precision technologies for high value specialised products from micro to very large sizes.

Smart manufacturing is a broad category of manufacturing that employs computer-integrated manufacturing, high levels of adaptability and rapid design changes, digital information technology, and more flexible technical workforce training (Wikipedia). A smart factory has interoperable systems, multi-scale dynamic modelling and simulation, intelligent automation, strong cyber security, and networked sensors. It can be viewed as a flexible system that can self-optimise performance across a broader network, self-adapt to and learn from new conditions in real or near-real time, and autonomously run production processes (Burke et al, 2017).

In the 4th industrial revolution, China plays an increasingly important role in manufacturing research and technology innovation. The guest editors invited leading research groups in China to submit papers reporting their latest research on the key issues in smart manufacturing, aiming to promote the publicity of their excellent research and sharing knowledge with the rest of the world. All papers in this special issue were authored by experts conducting significant research projects funded by Chinese government and industry. The standard

review process of the journal was followed, and 11 papers were selected and included in this issue, which are briefly introduced below:

The 1st paper entitled 'Digital Twin–oriented real-time cutting simulation for intelligent computer numerical control machining', authored by X Cao et al, reported research on simulation and digital twins. In-process part geometry and data are reflected in the digital twin which follows real machining process for on-line adaption by an intelligent CNC machining control system, with clear advantage over traditional off-line simulation systems which do not provide real dynamic data and interim status of components during machining.

The 2nd paper entitled 'Ontology-based modeling of part digital twin oriented to assembly', authored by Q Bao et al, also reported research related to digital twins. The digital twins of individual parts were established for assembly operations with the advantage of timely providing the actual geometry of features (obtained from inspection data) when parts are assembled, compared with current practice that only nominal geometry of features with specified tolerances in design stage are known when assembling parts. Lifecycle and historic data of parts are also available in the digital twins.

The 3rd paper entitled 'Kinematic modeling and control of mobile robot for large-scale workpiece machining', authored by B Tao et al, introduced a mobile robot set up for large-scale workpiece machining, with a kinematic model based control system to achieve constant machining speed, and to reduce the interacting forces between the mobile platform and the robot arm, in order to improve accuracy, safety and reliability. Large-scale workpieces such as wind turbine blades are very difficult (or even impossible) to be machined using traditional machining tools, and this experiment proved the feasibility of mobile robots in this type of applications.

The 4th paper entitled 'A Tabu-GA based parallel machine scheduling with restrained tool resources', authored by S Wang et al, studied a parallel machine scheduling problem combining operation scheduling, tool scheduling and limited resources. The Tabu-Genetic Algorithm was proposed to find the optimal solution to large scale complex problems. The focus was on adaptive planning in response to changes of tools during production in terms of individual tool life, wear, limitation and conflicts, with clear advantages over Tabu search algorithm and genetic algorithm in selecting local and global optima.

The 5th paper entitled 'Chatter identification in thin-wall milling using an adaptive VMD method combined with the decision tree model', authored by R Wang et al, addressed the chatter problem in precision machining of thin-wall parts, using methods based on adaptive variational mode decomposition and decision trees. Improved computational efficiency, effectiveness, accuracy and adaptiveness in on-line dynamic chatter identification have been achieved, compared with existing methods based on empirical thresholds.

The 6th paper entitled 'A subjective-objective evaluation method of hole surface quality in drilling CFRP-Ti Stacks', authored by S Liu et al, addressed surface

quality issues in drilled holes of carbon fiber-reinforced plastics and titanium alloys which is a key factor affecting high-precision assembly and reliable usage of the structures such as in aerospace products. Compared with traditional quantitative methods, subjective method based on analytic hierarchy process (AHP) was combined with quantitative methods in weight calculation, hence more reasonable, effective and acceptable evaluation results can be achieved.

The 7th paper entitled 'Advances in grinding technology in China with application in steel roller manufacturing', authored by L Wang et al, presented an overview of the state-of-the-art and emerging intelligent technologies in China's roller grinding industry, including high-speed spindle and grinding machine platforms, high-performance tooling design, in-process profile accuracy measurement and compensation, and intelligent process parameter optimisation. Future trends in roller grinding machines and production lines towards smart and intelligent manufacturing were also identified and summarised.

The 8th paper entitled 'Mechanisms for the Scratching of Monocrystalline SiC with a Diamond Grit at Different Wear Stages', authored by Q Liu et al, explored the mechanisms of the scratching of monocrystalline silicon carbide with a single diamond grit. A smoothed particle hydrodynamics method was used to simulate the scratching process. The findings of this article would be of benefit to the optimal selection of machining parameters and the optimal design of diamond tools for abrasive machining of monocrystalline silicon carbide.

The 9th paper entitled 'Rapid CO2 laser processing technique for fabrication of micro-optics and micro-structures on fused silica materials', authored by L Zhao et al, reported a multi-step processing strategy with the combination of various processing technologies for the fabrication of micro-optics and micro-structures which are important in the field of optics. The advantage of this strategy is that the proposed rapid CO2 laser processing operations can be realised with a single equipment, which can not only ensure the processing accuracy and efficiency, but also reduce the processing cost.

The 10th paper entitled 'Prediction of tool wear width size and optimization of cutting parameters in milling process using ANFIS with novel PSO algorithm', authored by L Xu et al, proposed a novel learning algorithm for the prediction of tool wear and optimisation of machining parameters to prolong tool life. The experimental results showed that their adaptive network–based fuzzy inference system trained by random vibration and cross particle swarm optimisation algorithms gave more accurate predicted values for offline prediction of tool wear widths, compared with current similar methods.

The 11th paper entitled 'An accurate cutting tool wear prediction method under different cutting conditions based on continual learning', authored by J Hua et al, also addressed tool wear issues, and proposed a novel method for predicting tool wear in different cutting conditions based on continuous learning. A model is trained for specific cutting conditions and can be easily fine-tuned with very small number of samples. Compared with existing learning methods, the

proposed method can predict tool wear in real-time, under different cutting conditions, more accurately and using much smaller sample data.

The last 2 papers, i.e., 'Development of an enhanced single point milling procedure to screen metalworking cutting fluid performance in terms of tool wear when machining aerospace alloys' authored by T Khan et al, and 'Applying Experimental Micro-tool wear Measurement techniques to Industrial Environments' authored by L Alhadeff et al, are not part of this special issue. They are published in this issue because they both addressed tool wear issues and can be read in addition to papers 10 & 11 by researchers and industrialists interested in the tool wear research area. The former focused on industrial applications of micro-tool wear measurement techniques with higher technology readiness level, while the latter aimed at improving efficiency of experiments in laboratories using a single point (as opposed to multiple inserts) milling tool to test parameters of different cutting fluids for improving tool life.

We would like to express our sincere thanks to all the authors and international peer reviewers for their contribution to the high quality papers presented in this special issue, that will stimulate knowledge sharing and potential collaboration between international researchers and practitioners in this important field.

Guest Editors:
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